(12) UK Patent Application (19) GB (11) 2 286 406 (13) A

(43) Date of A Publication 16.08.1995

(21) Application No 9500088.1

(22) Date of Filing 04.01.1995

(30) Priority Data
(31) 06002507 (32) 14.01.1994 (33) JP
06165131 18.07.1994

(51) INT CL[6]
D06F 23/04 37/26

(52) UK CL (Edition N)
D1A AFB

(56) Documents Cited
GB 2249847 A US 5205141 A

(58) Field of Search
UK CL (Edition N) D1A AAB AB ADB ADC AFB AFX AX
INT CL[6] D06F 23/00 23/04 25/00 37/02 37/26 39/12
ONLINE: WPI

(71) Applicant(s)
Kabushiki Kaisha Toshiba

(Incorporated in Japan)

72 Horikawa-Cho, Saiwai-Ku,Kawasaki-Shi, Kanagawa-Ken, Japan

(72) Inventor(s)
Yoshiyuki Miwa
Masatsugu Wada
Tatsuo Toku

(74) Agent and/or Address for Service
Marks & Clerk
57-60 Lincoln's Inn Fields, LONDON, WC2A 3LS, United Kingdom

(54) Automatic washing machine with water saving type rotatable tub

(57) An automatic washing machine includes a rotatable tub (8) and an inner basket (21) formed from a metal. The inner basket (21) is formed into a cylindrical shape and has a number of water-passing holes 24 in its circumferential wall. The inner basket (21) is disposed in the rotatable tub (8) so as to be in close vicinity to the inner circumferential wall of the rotatable tub (8). A recirculating path is ensured between the rotatable tub (8) and the inner basket (9) so that water is centrifugally caused to rise up through the path in a dehydration step, so that the water flows through the path to a drain hole (10) in a drainage path and that the water is caused to pass through the path for the capturing of lint. Additionally, the reinforcement accorded by the inner basket comprises the mechanical strength of the rotatable tub (8) and allows a higher speed of rotation in the dehydration step to be used.

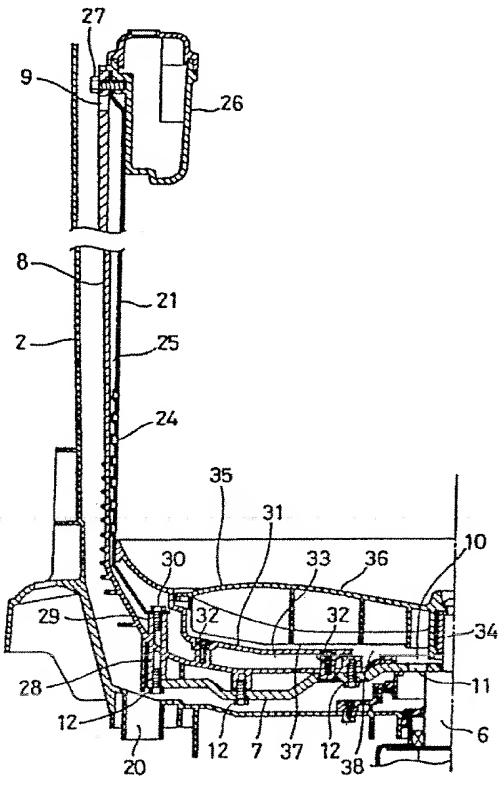

FIG. 1

GB 2 286 406 A

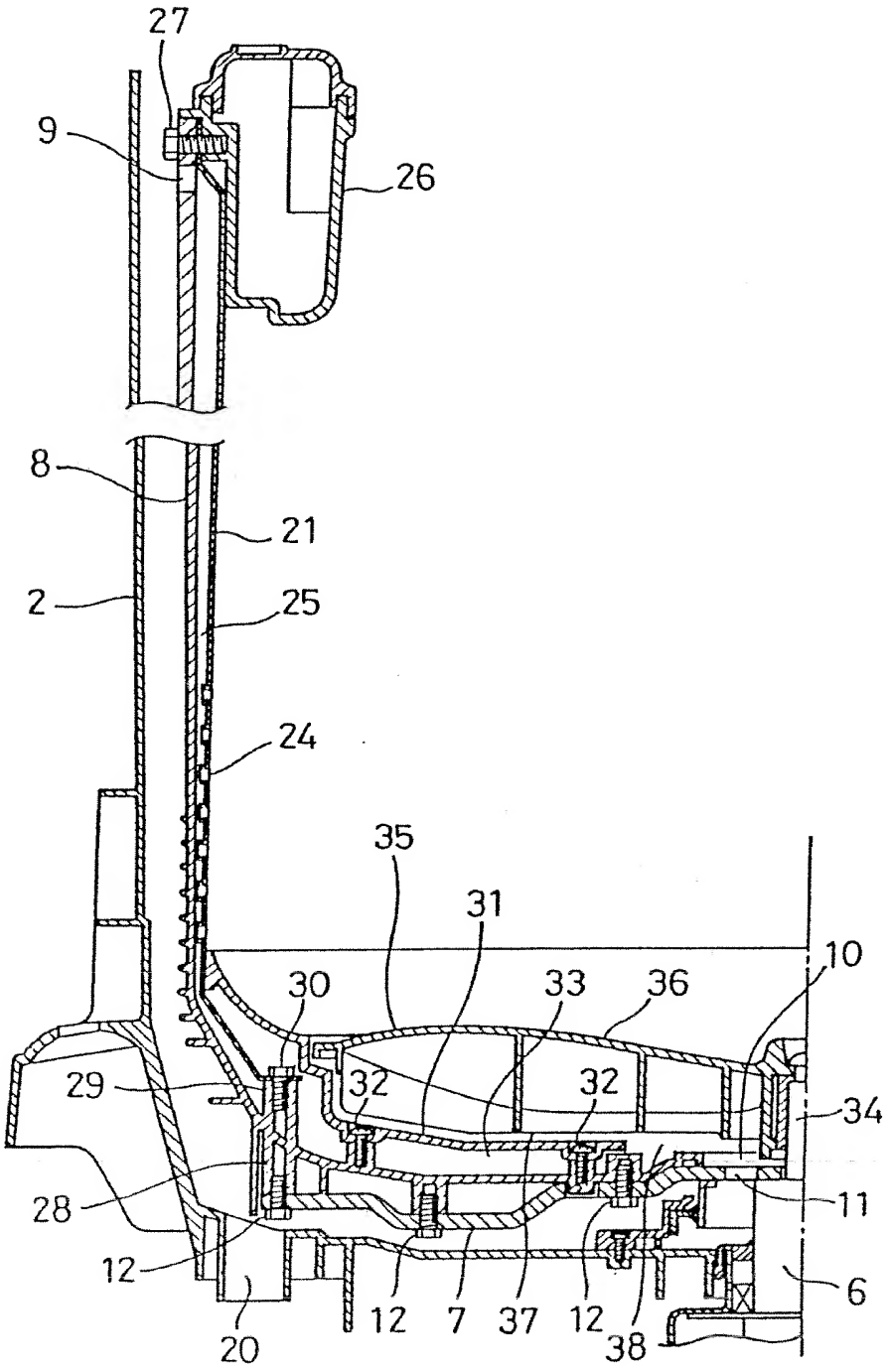
27
9
26
8
21
2
25
24
35
31
10
30
33
36
29
32
32
34
28
11
12
6
12
7
37
12
38
20

FIG. 1

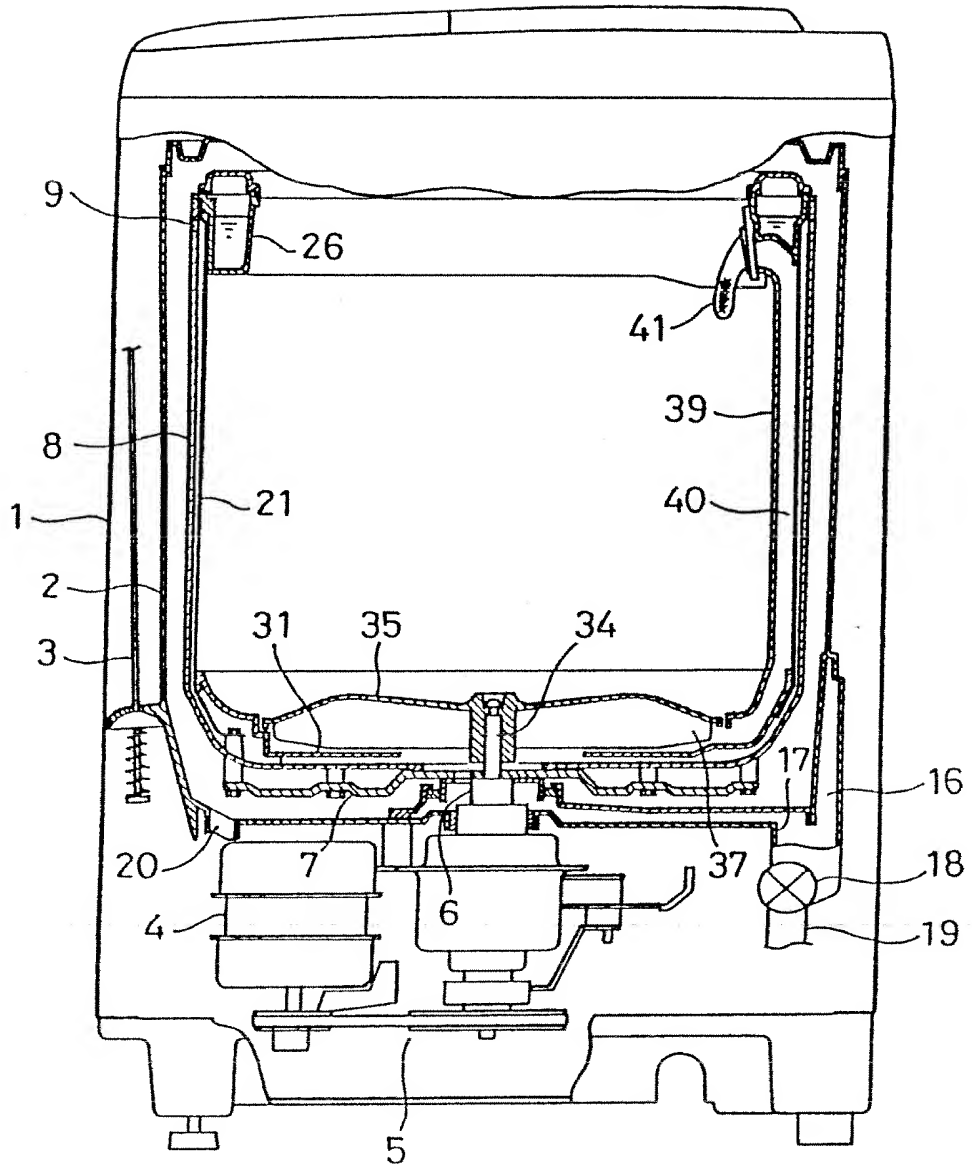

FIG. 2

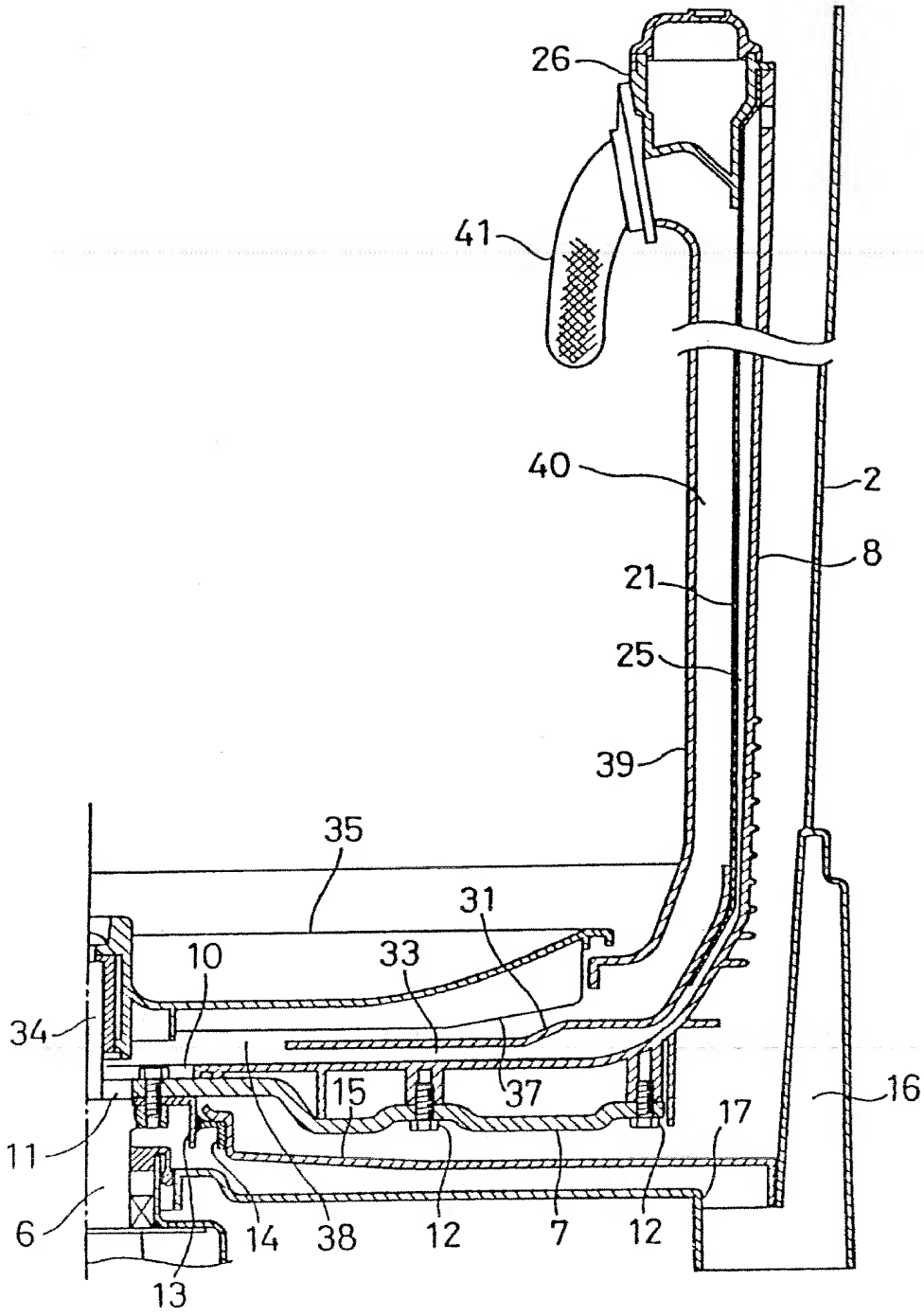

FIG. 3

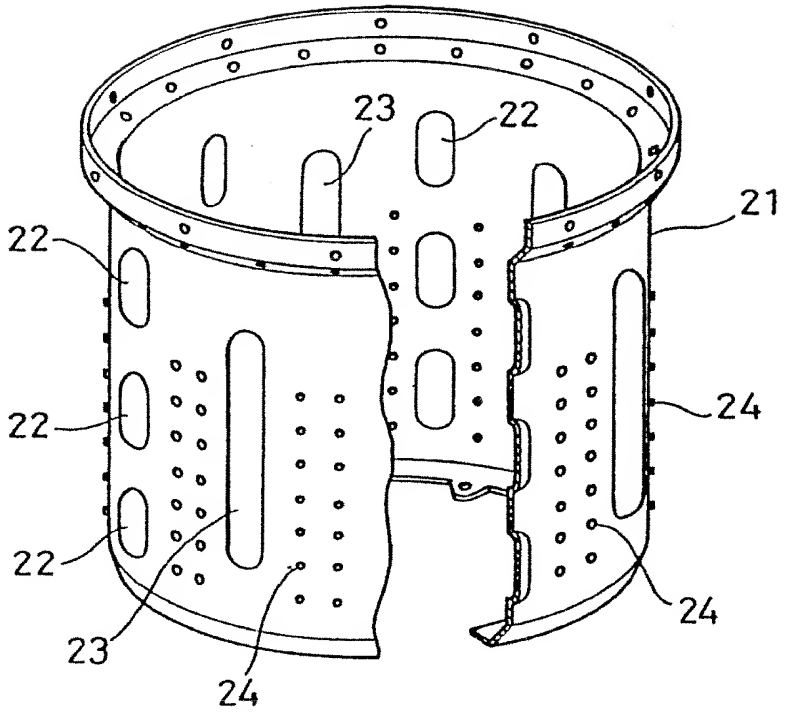

FIG. 4

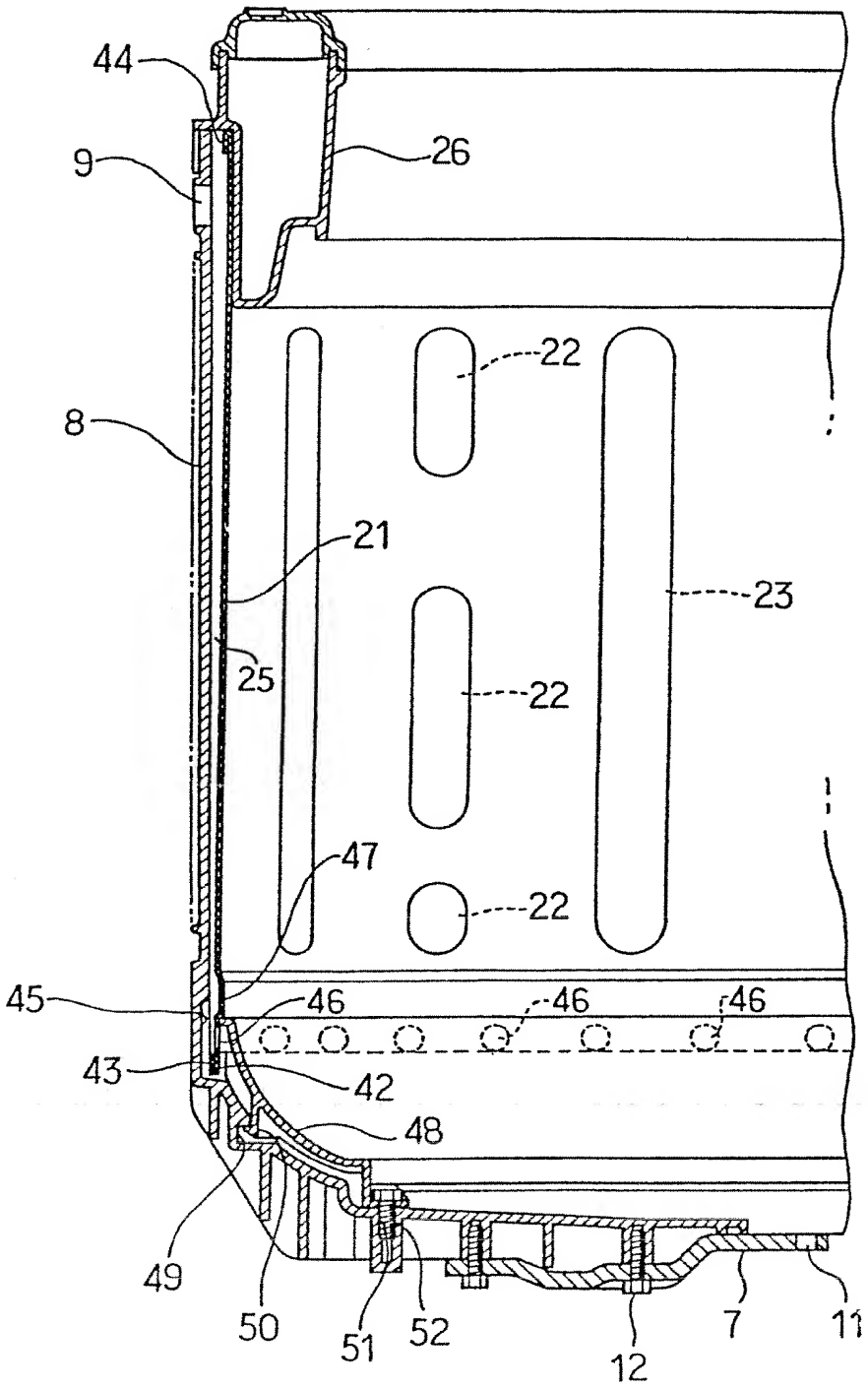

FIG. 5

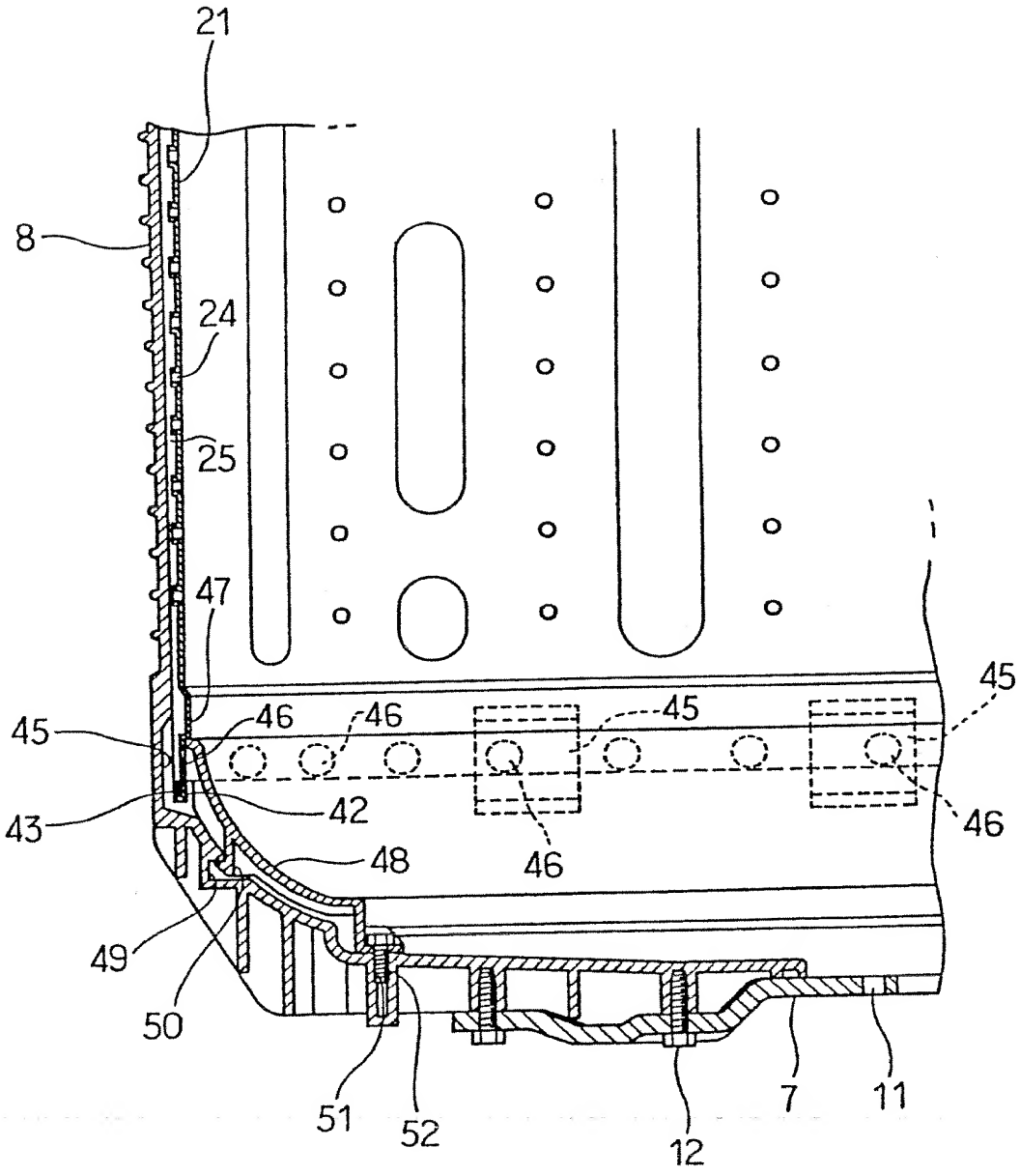

FIG. 6

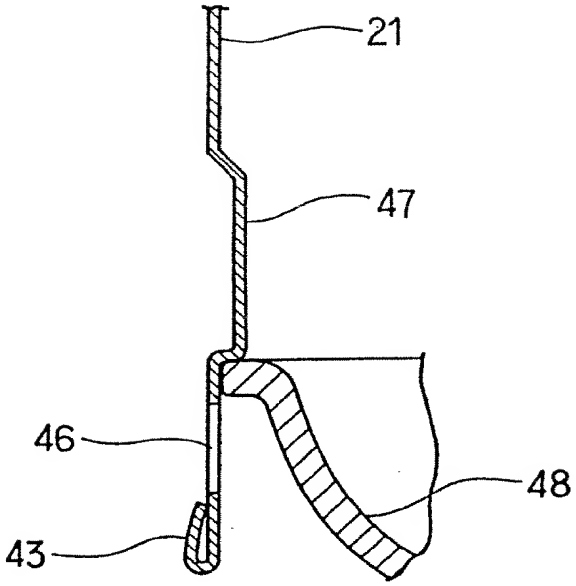

FIG. 7

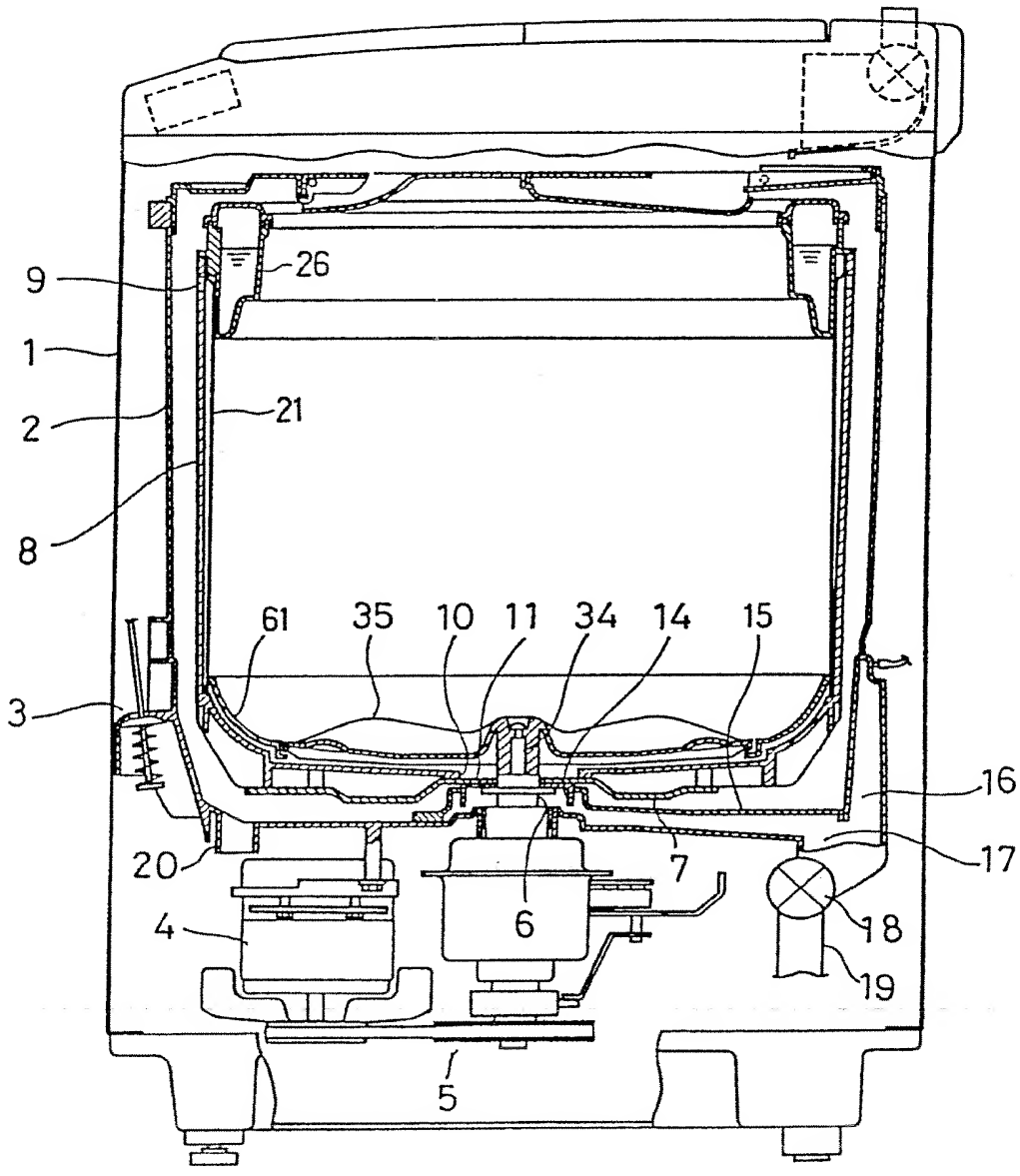

FIG. 8

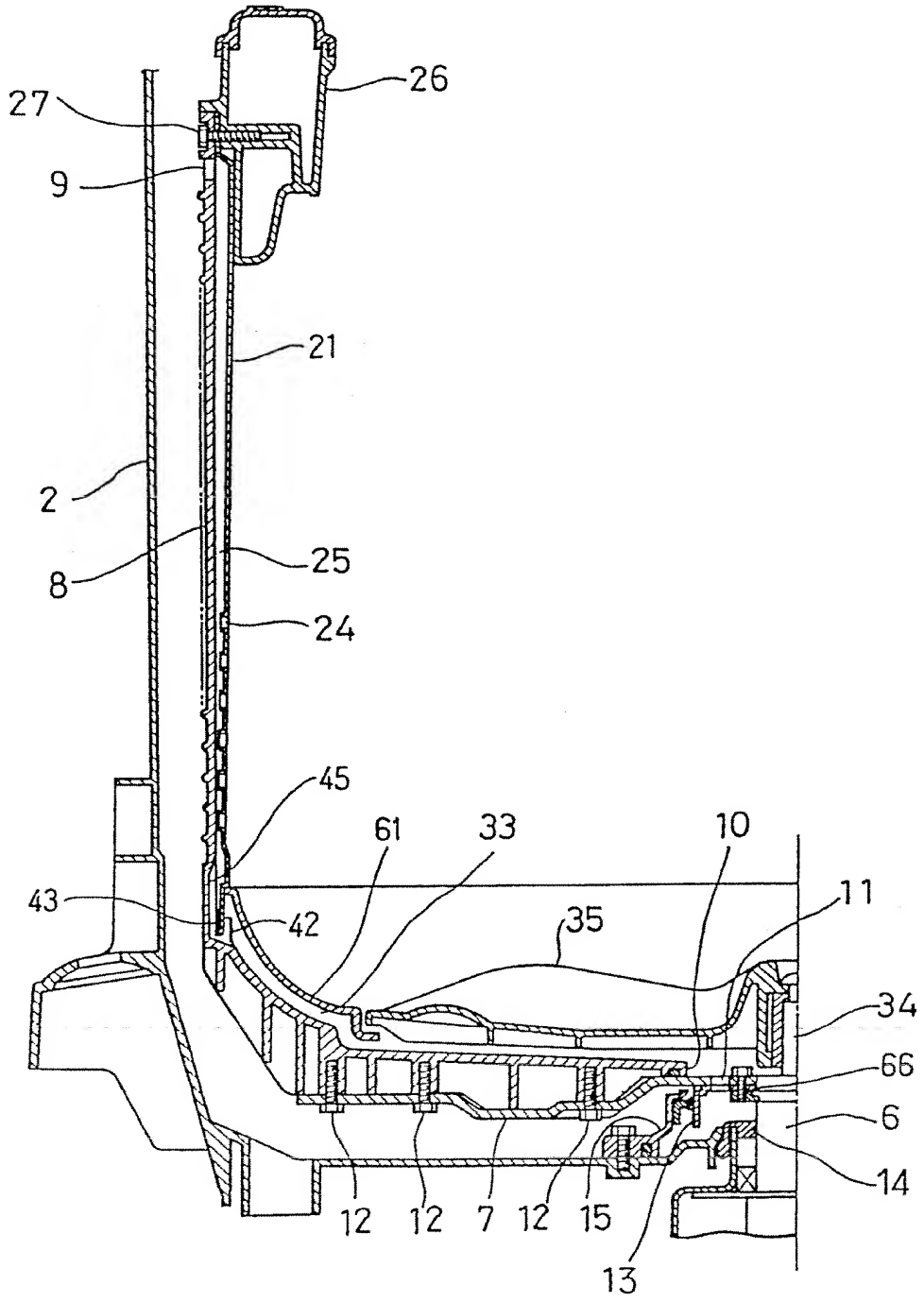

FIG. 9

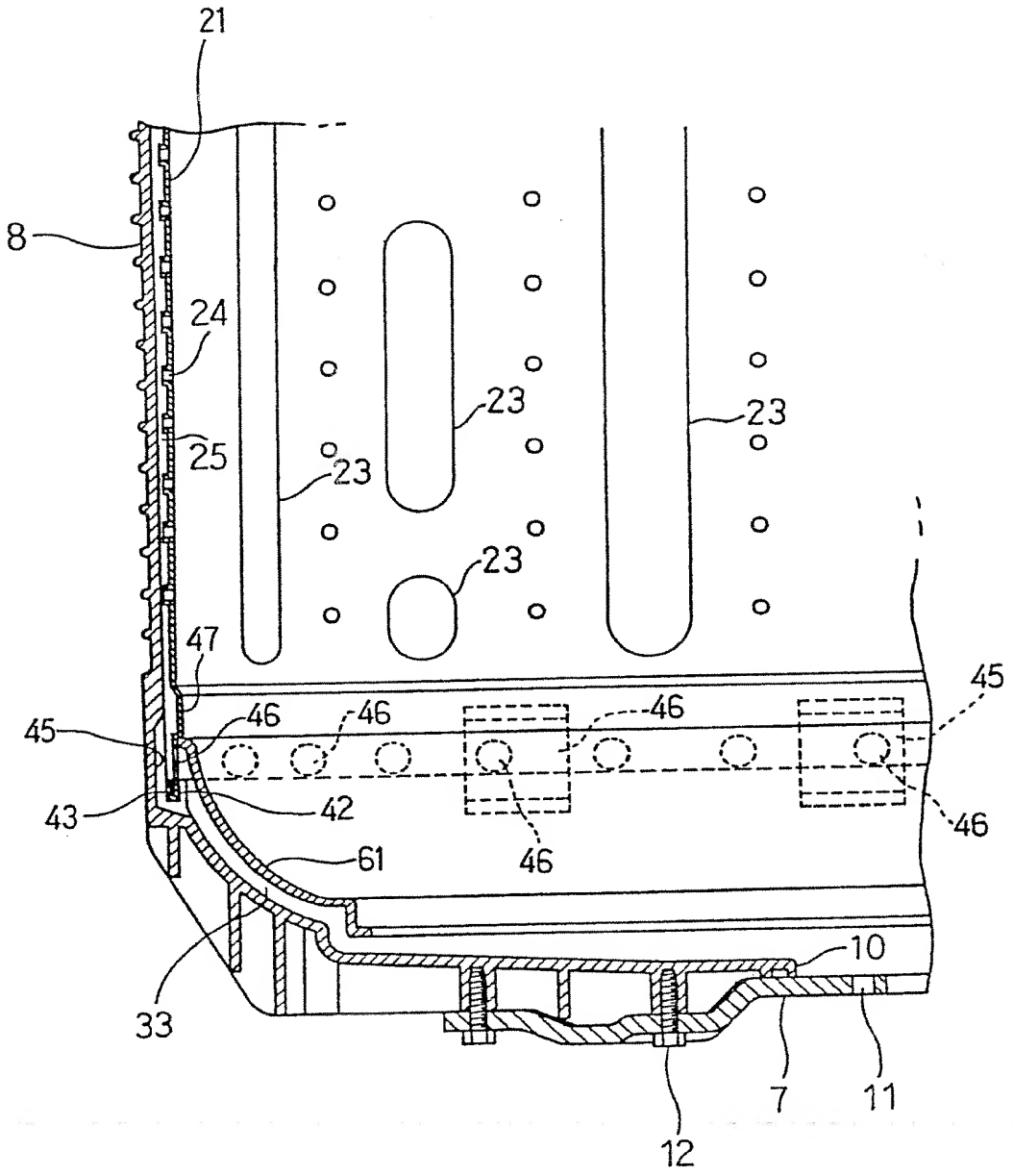

FIG. 10

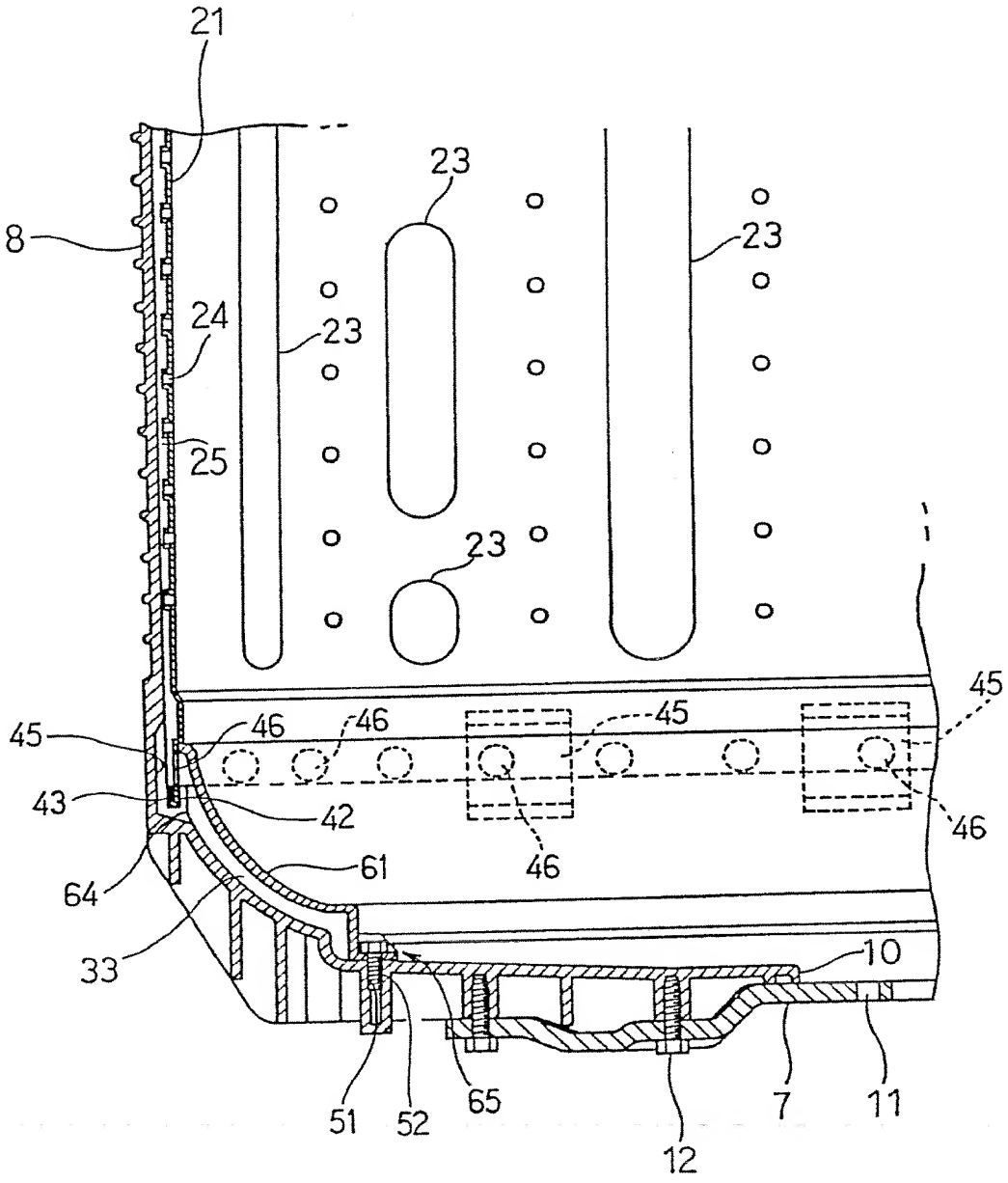
21
23
8
23
24
23
25
23
45
45
46
46
45
45
43
42
46
46
64
61
33
10
51
52
65
12
7
11

FIG. 11

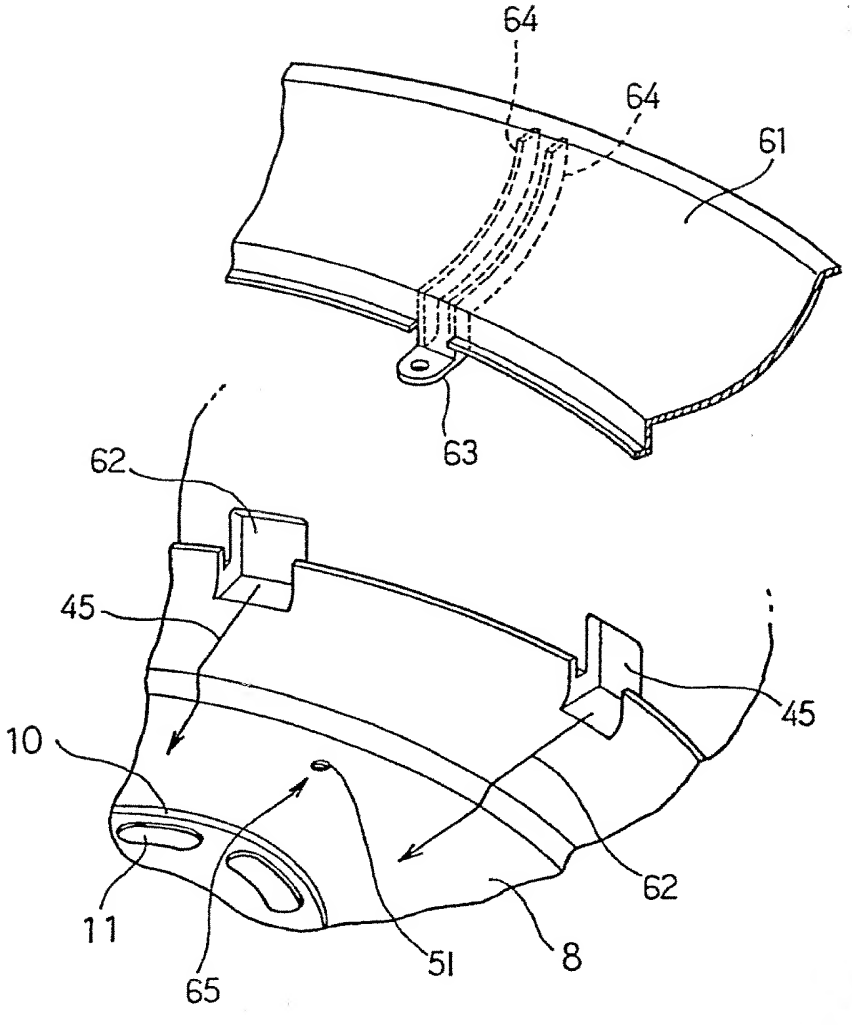

FIG. 12

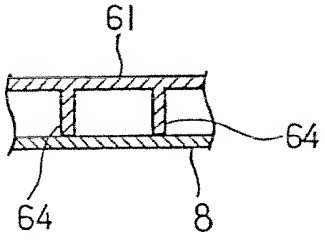

FIG. 13

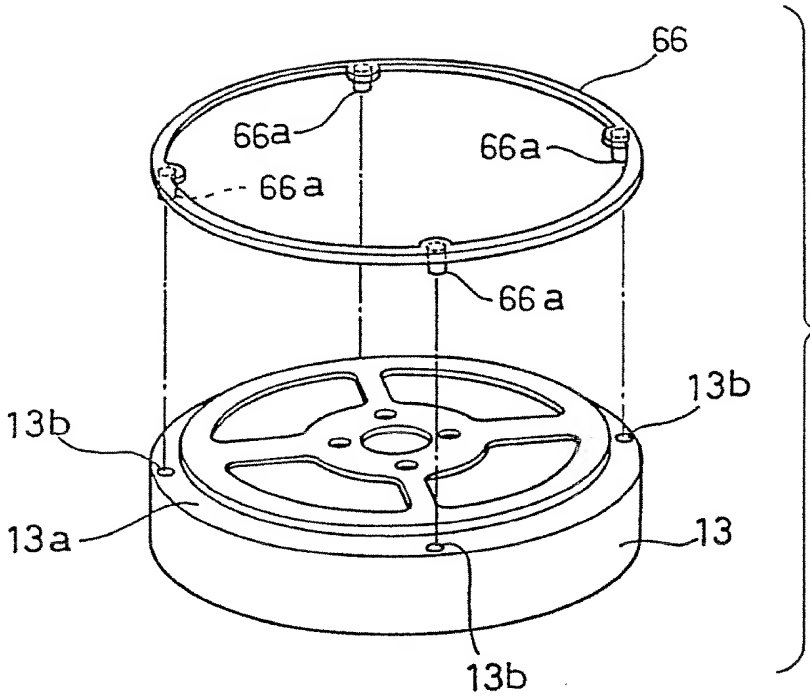

FIG. 14

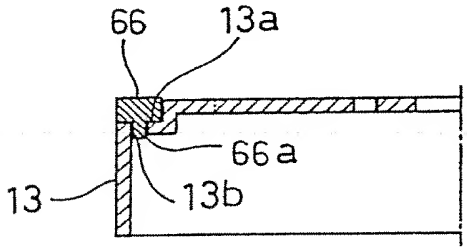

FIG. 15

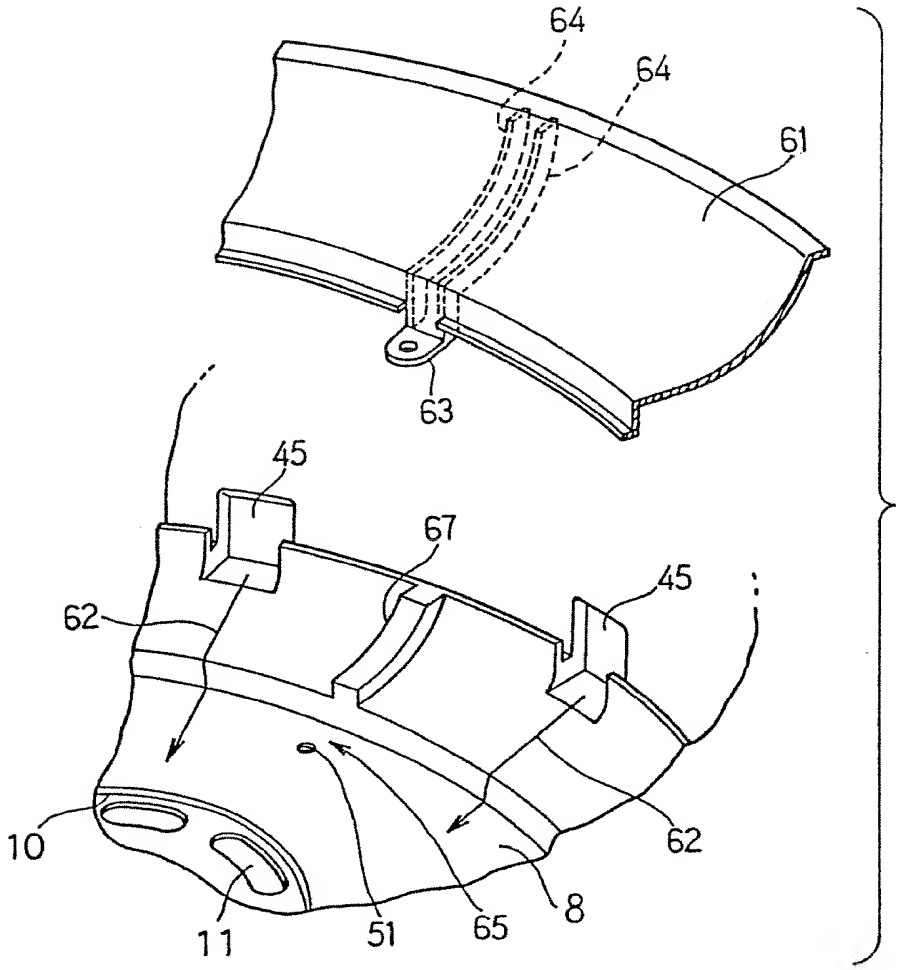

FIG. 16

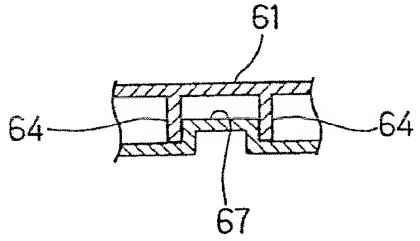

FIG. 17

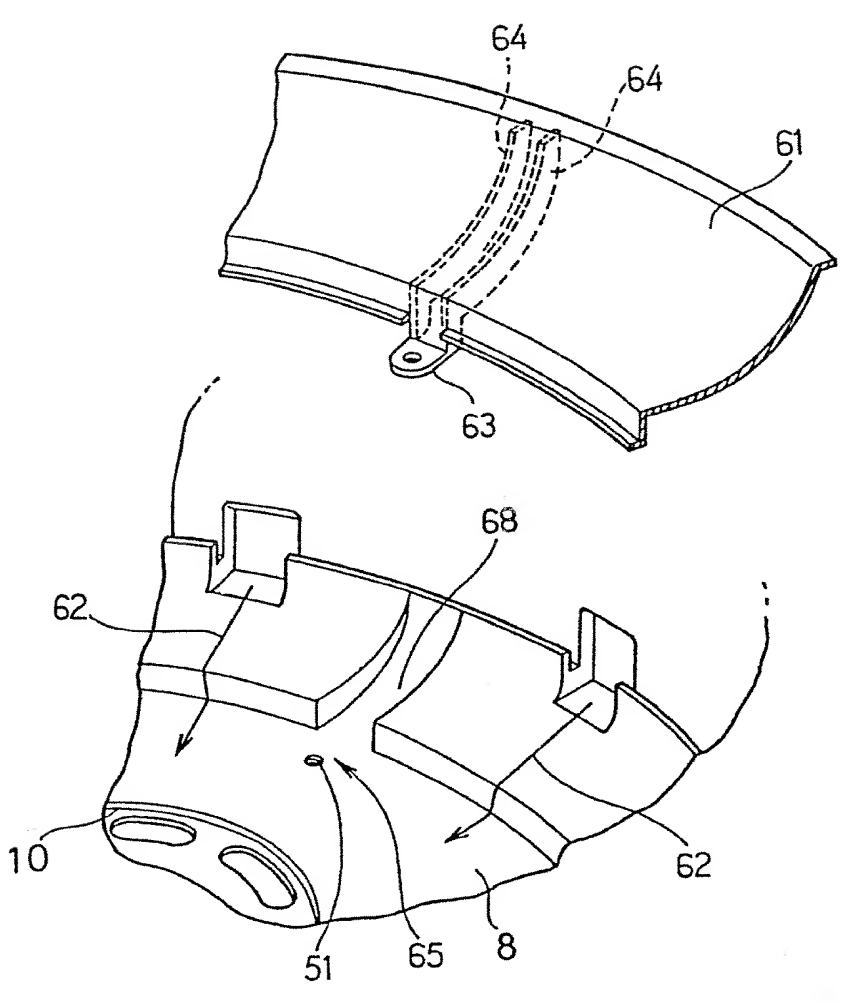

FIG. 18

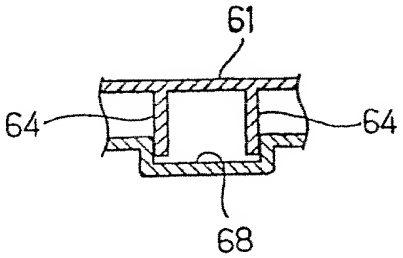

FIG. 19

2286406

AUTOMATIC WASHING MACHINE WITH WATER SAVING TYPE ROTATABLE TUB

This invention relates to an automatic washing machine having a tub of the type that enhances water saving.

The prior art has provided automatic washing machines having water-saving type tubs. These automatic washing machines comprise a rotatable tub serving both as a wash tub and as a dehydrating basket. The rotatable tub has dehydrating holes formed in the upper circumferential wall thereof. A predetermined amount of water is supplied into the rotatable tub in a wash step. The rotatable tub is rotated in a dehydration step so that the water is caused to centrifugally rise up along the inner circumferential wall of the rotatable tub so that the water is discharged through the dehydrating holes out of the tub.

The diameter of the rotatable tub is gradually increased from the lower end to the upper end thereof so that the pumping efficiency and that is, the dehydrating efficiency is improved. The rotatable tub further has a drain hole formed in the bottom thereof so that the wash liquid is drained through the same out of the tub. A water flow path for capturing lint is defined vertically along the inner circumferential wall of the rotatable tub. A lint filter is located at one end of the water flow path. When an agitator rotatably mounted on the bottom of the rotatable tub is driven in the wash step, outvanes of the agitator causes the water to flow into the water flow path so that

the water is recirculated in the rotatable tub, whereby lint contained in the water is captured by the lint filter.

The above-described prior art construction has the following drawbacks. First, a centrifugal force caused by rotation of the rotatable tub presses clothes against the inner circumferential wall of the rotatable tub, whereupon the clothes obstruct the water from flowing upwardly along the inner circumferential wall of the rotatable tub. Consequently, the dehydrating efficiency is reduced. Second, since the rotatable tub is generally formed from a plastic material, the rotatable tub cannot be rotated at a sufficiently high speed during the dehydration step in view of low mechanical strength thereof. Consequently, a sufficient dehydrating performance cannot be obtained. Third, the clothes obstruct the flow of water directed toward the drain hole at the time of drainage. Thus, the water cannot be discharged efficiently at the time of drainage. The clothes also obstruct the flow of water recirculated by the action of the outvanes of the agitator in the wash step, so that the lint cannot be captured efficiently. Fourth, not a little amount of water flows through the dehydrating holes out of the rotatable tub in the wash step. Consequently, the amount of water in the rotatable tub becomes insufficient and accordingly, the clothes tend to be damaged. Fifth, the centrifugal force sometimes causes the clothes to rise up along the inclined inner circumferential surface of the rotatable tub in the dehydration step, resulting in rotation of the tub in the

unbalanced state and resultant abnormal vibration of the tub.

Therefore, an object of the present invention is to provide an automatic washing machine wherein the washing operation, the dehydrating operation, the drainage and the capture of lint can be performed efficiently and sufficiently.

Another object of the present invention is to provide an automatic washing machine wherein the wash step can be executed without reduction in an amount of water in the tub, a sufficient volume can be ensured in the tub, and productivity and assembling efficiency can be improved.

The present invention provides an automatic washing machine comprising a tub provided for reserving a predetermined amount of water, the tub including a circumferential wall having a number of dehydrating through holes formed in an upper portion of the circumferential wall so as to be arranged circumferentially of the tub, the tub being rotated in a dehydration step so that the water is discharged through the dehydrating holes, and an inner basket formed into a generally cylindrical shape and including a circumferential wall having a number of water-passing holes, the inner basket being disposed in close vicinity to the inner circumferential surface of the tub.

According to the above-described construction, paths along which the water rises up along the inner circumferential wall of the tub are defined between the inner basket and the inner circumferential surface of the

tub outside the inner basket. Consequently, the dehydration can smoothly be performed without obstruction by the clothes.

The inner tub may be formed from a metal. This improves the mechanical strength of the tub. Consequently, the tub can be rotated at high speeds in the dehydration step. The inner basket may have upper and lower ends fixed to the tub. Consequently, the durability of the inner basket against rotation of the tub can be improved. The automatic washing machine may further comprise a tub mounting disc on which the tub is mounted and the inner basket may be connected to the tub mounting disc. In this construction, the durability of the inner basket can further be improved. The automatic washing machine may further comprise a balancing ring mounted on the upper portion of the tub and the upper end of the inner basket may be secured to the tub together with the balancing ring. In this construction, the durability of the upper portion of the inner basket can be improved and parts for mounting the balancing ring on the tub can be commonly used for securing the upper end of the inner basket to the tub.

The tub may have a bottom provided with a drain hole and the washing machine may further comprise a bottom cover provided between the inner basket and the drain hole so that a space defined between the tub and the inner basket communicates with the drain hole. The bottom cover provides a drainage path extending from the outside of the inner basket to the drain hole. Consequently, the wash liquid can

smoothly be drained without obstruction by the clothes. The washing machine may further comprise a water flow path defining cover disposed along the inner circumferential wall of the tub so as to define a water flow path for capturing lint between the same and the inner circumferential wall of the tub, an agitator rotatably mounted on the bottom of the tub, the agitator directing the water from a backside water absorbing area to the lint capturing water flow path, and a bottom cover provided between the inner basket and the backside water absorbing area so that a space defined between the tub and the inner basket communicates with the backside water absorbing area. The bottom cover provides a recirculation flow path extending from the outside of the inner basket to the drain hole. Consequently, since the water can smoothly be recirculated without obstruction by the clothes, the lint can efficiently be captured. In this regard, the bottom cover may be discrete from the inner basket. The inner basket can be produced only by rounding a metal plate and connecting both ends thereof together. This can improve the productivity of the washing machine. Furthermore, the bottom plate may be formed from a metal.

The number of the water-passing holes formed in the inner basket may be larger in the lower portion of the circumferential wall thereof than in the upper portion of the circumferential wall thereof. As the result of this construction, an amount of wash liquid reaching the dehydrating holes of the tub from the interior of the inner basket can be reduced. The water-passing holes may be

formed by squeezing the circumferential wall of the inner basket outwardly from the inner surface thereof. Since the clothes can be prevented from being caught by the edges of the water-passing holes in this construction, they can be prevented from being damaged. The inner basket may have a number of expanding portions expanding outwardly of the circumferential wall thereof so that a space is defined between the expanding portions and the inner circumferential wall of the tub. Consequently, the paths along which the water rise up in the dehydration step can be ensured more reliably. In this regard, the expanding portions of the inner basket may include vertically shorter and longer expanding portions alternately arranged circumferentially of the inner basket, so that the water flow and the movement of the clothes can be rendered complicate in the wash step. Additionally, the diameter of the inner basket may be substantially the same from the lower end to the upper end thereof or the diameter of the inner basket is smaller at the upper end side than at the lower end side. In this construction, the clothes can effectively be prevented from rising up along the inner circumferential wall of the inner basket in the dehydration step.

The tub may have a groove circumferentially formed in the lower portion thereof and the lower end of the inner basket is fitted in the groove of the tub so that the inner basket is fixed in position. Since the inner basket need not be formed with a flange or the like on which the inner basket is fixed to the tub by screws, substantial reduction

in the volume thereof can be avoided as compared with the construction in which the inner basket is fixed to the tub by the screws. Furthermore, since a screwing work performed deep in the bottom of the tub is not required and the lower end of the inner basket is not exposed. Consequently, lint can be prevented from sticking to the lower end of the inner basket. Furthermore, the inner basket may have a folded portion in the lower end thereof and the folded portion of the inner basket may be fitted in the groove of the tub. When the inner basket is fitted into the groove of the tub, the lower end of the inner basket can be prevented from being caught by a portion of the tub. Furthermore, the strength of the lower end of the inner basket can be increased.

The tub may have a plurality of water-passing concavities formed in the lower portion thereof so as to be contiguous with the groove and positioned outside the lower end of the inner basket and so as to be spaced from one another circumferentially along the groove, whereby the space defined between the tub and the inner basket communicates with a space located below the lower end of the inner basket. Consequently, a drainage path extending from the space between the tub and the inner basket can reliably be ensured. Furthermore, the inner basket may have a number of communicating holes formed in the lower portion thereof so that the water-passing concavities of the tub and the space between the tub and the inner basket communicate with a space inside the inner basket via the communicating holes.

The drainage path from the space between the tub and the inner basket can more reliably be ensured by the provision of the water-passing concavities and the communicating holes. Furthermore, the inner basket may have a stepped portion formed in the lower portion thereof and inwardly projecting so that the stepped portion abuts against the upper edge of the bottom cover. The stepped portion prevents the clothes from being caught by the interface between the inner basket and the bottom cover.

The tub may have a drain hole formed in the bottom thereof and a plurality of water-passing concavities formed in the lower circumferential wall thereof so that a water flow path is defined between inner basket and the tub. The washing machine may further comprise a bottom cover fixed to the bottom of the tub so that a space is defined between the same and the lower circumferential wall of the tub and extends from each water-passing concavity to the bottom of the tub, whereby the space between the inner basket and the tub communicates with the drain hole. The tub may have a fixing portion formed in the portion thereof other than the portion defining a main drain path extending substantially linearly from each water-passing concavity to the drain hole side, the bottom cover being fixed to the fixing portion of the tub. Since the water from the space between the tub and the inner basket scarcely passes through the fixing portion, the lint can be prevented from being caught by the fixing portion and accordingly, a mass of lint can be prevented from being formed at the fixing portion. Consequently, the

draining efficiency can be prevented from being lowered.

Either the underside of the bottom cover or a portion of the bottom of the tub opposite to the underside of the bottom cover may have a pair of ribs opposite to each other with a space therebetween larger than the width of the fixing portion of the tub and extending to the rear of the fixing portion so that the rear space is isolated from the water-passing concavities. Consequently, the water from the water-passing concavities can be prevented from passing through the rear of the fixing portion. Furthermore, the other of the two may have a convexity fitted in the space between the ribs. In this construction, the water can be further prevented from passing through the rear of the fixing portion. Additionally, the bottom cover can readily be positioned in the assembly of the washing machine. Instead of the above convexity, a concavity in which the ribs are fitted may be provided.

The invention will be described, merely by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a partial longitudinal section of one half of an automatic washing machine of a first embodiment in accordance with the present invention;

FIG. 2 is a longitudinal section of the washing machine;

FIG. 3 is a partial longitudinal section of the other half of the washing machine;

FIG. 4 is a partially broken perspective view of an

inner basket of the washing machine;

FIG. 5 is a longitudinal section of one half of a tub employed in an automatic washing machine of a second embodiment in accordance with the present invention;

FIG. 6 is a longitudinal section of the lower portion of the tub shown in FIG. 5;

FIG. 7 is a longitudinal section of the lower end of an inner basket and the upper end of a bottom cover of the washing machine;

FIG. 8 is a view similar to FIG. 2, showing an automatic washing machine of a third embodiment in accordance with the present invention;

FIG. 9 is a view similar to FIG. 1, showing the washing machine of the third embodiment;

FIG. 10 is a longitudinal section of one half of the tub employed in the washing machine of the third embodiment;

FIG. 11 is a longitudinal section as viewed from a different angle from that of FIG. 10;

FIG. 12 is a partial exploded perspective view of the bottom of a tub and a bottom cover employed in the washing machine of the third embodiment;

FIG. 13 is a longitudinal front view of a pair of ribs;

FIG. 14 is an exploded perspective view of a seal metal and a packing;

FIG. 15 is a partial longitudinal section of the seal metal and the packing;

FIG. 16 is a view similar to FIG. 10, showing an automatic washing machine of a fourth embodiment in

accordance with the present invention;

FIG. 17 is a view similar to FIG. 11, showing the washing machine of the fourth embodiment;

FIG. 18 is a view similar to FIG. 10, showing an automatic washing machine of a fifth embodiment in accordance with the present invention; and

FIG. 19 is a view similar to FIG. 11, showing the washing machine of the fifth embodiment.

A first embodiment of the present invention will be described with reference to FIGS. 1 to 4. Referring first to FIG. 2, an overall construction of an automatic washing machine of the first embodiment is shown. An outer cabinet 1 encloses an outer tub 2 mounted on a plurality of suspension means 3 one of which is shown. An electric motor 4 and a drive mechanism 5 are provided below the tub 2. The drive mechanism 5 includes a dehydrating drive shaft 6 extending upwardly through the bottom of the outer tub 2. A tub-mounting disc 7 is secured to the upper extending end of the drive shaft 6.

A rotatable tub 8 is rotatably mounted in the outer tub 2. The rotatable tub 8 is formed from a plastic material, for example. The diameter of the rotatable tub 8 is gradually increased from its lower to its upper portion. The rotatable tub 8 has a number of dehydrating through holes 9 circumferentially formed in an upper portion of its circumferential wall, as shown in FIG. 1. The rotatable tub 8 further has a drain hole 10 formed in the central bottom thereof. In mounting the rotatable tub 8 on the tub-

mounting disc 7, the tub 8 is placed on the disc 7 with the drain hole 10 lying on a plurality of water-passing holes 11 formed in the central portion of the disc 7. The tub 8 is then secured to the disc 7 by a plurality of screws 12. The motor 4 drives the dehydrating drive shaft 6 in a dehydration step so that the rotatable tub 8 is rotated. The water-passing holes 11 communicate via a seal metal 13, a seal 14 and a duct 15 with a first drain hole 17 of the outer tub 2 adjacent to a water-level detecting air trap 16. The air trap 16 and the first drain hole 17 communicate with a drain hose 19 via a drain valve 18, the latter two being shown in FIG. 2. The outer tub 2 further has a second drain hole 20 formed in the left-hand bottom thereof, as viewed in FIG. 2. The second drain hole 20 communicates directly with the drain hose 19 although the communication is not shown.

An inner basket 21 is mounted in the rotatable tub 8. The inner basket 21 is formed from a metal and more specifically, it is formed by rounding a stainless steel plate and connecting both ends together by means of caulking. The inner basket 21 is formed into such a cylindrical shape that the diameter thereof is substantially the same from the lower end to the upper end thereof or that the diameter thereof is smaller at the upper end side than at the lower end side. The inner basket 21 has a number of short expanding portions 22 and long expanding portions 23 each expanding outwardly from the circumferential wall thereof and a number of water-passing through holes 24 formed in the portion of the circumferential wall thereof

other than the expanding portions 22 and 23. Rows of three short expanding portions 22 and the long expanding portions 23 are alternately arranged circumferentially of the inner basket 21. The number of the water-passing holes 24 formed in the inner basket 21 is larger in the lower circumferential wall thereof than in the upper circumferential wall thereof. Each water-passing hole 24 is formed by squeezing the circumferential wall of the inner basket 21 outwardly from the inner surface thereof.

The inner basket 21 is disposed in close vicinity to the inner circumferential surface of the rotatable tub 8 so that the expanding ends of the expanding portions 23 and 23 abut against the inner circumferential surface of the tub 8, as shown in FIG. 1. Consequently, a space 25 is defined between the outer circumferential surface of the inner basket 21 and the inner circumferential surface of the rotatable tub 8. The upper end of the inner basket 21 is secured by screws 27 to the upper portion of the rotatable tub 8 immediately over the dehydrating holes 9 together with a balancing ring 26. On the other hand, the lower end of the inner basket 21 is secured by screws 30 to inner bosses 29 projecting upwardly from the bottom of the rotatable tub 8 and coaxial with bosses 28 for securement of the tub-mounting disc 7. Consequently, the inner basket 21 is fixed to the rotatable tub 8 so as to be indirectly connected to the tub-mounting disc 7.

A bottom cover 31 formed from a plastic material, for example, extends from the inner lower wall of the inner

basket 21 toward the drain hole 10. The bottom cover 31 is discrete from the inner basket 21. The bottom cover 31 is secured to the bottom of the rotatable tub 8 by screws 32 so that a space 33 is defined therebetween. The space between the rotatable tub 8 and the inner basket 21 communicates with the drain hole 10 via the space 33.

A washing drive shaft 34 upwardly projects from the upper end of the dehydrating shaft 6 of the drive mechanism 5, extending through the bottom of the rotatable tub 8, as shown in FIG. 2. The washing drive shaft 34 is driven in a wash step. An agitator 35 is secured to the upper end of the washing drive shaft 34. The agitator 35 comprises an upper vane 36 for producing washing water flows and a lower vane 37 for producing recirculating water flows for capturing lint as shown in FIG. 1. The agitator 35 has a number of water-passing holes (not shown) formed in the body thereof. A backside water absorbing area 38 for the lower vane 37 communicates with the space 33 defined between the bottom of the rotatable tub 8 and the bottom cover 31, so that the space 25 between the rotatable tub 8 and the inner basket 21 communicates with the backside water absorbing area 38. See FIGS. 1 and 3.

A water flow path defining cover 39 is provided inside the inner basket 21 along the inner circumferential wall of the tub 8. The upper end of the cover 39 is attached to a lint filter 41 while its lower end faces the outer periphery of the lower vane 37 of the agitator 35, thereby defining a water flow path 40 extending from the bottom of the

rotatable tub 8 to the balancing ring 26. Consequently, the flow of water produced by the lower vane 37 of the agitator 35 is directed to the water flow path 40.

Since the dehydrating holes 9 are formed only in the upper portion of the rotatable tub 8, the agitator 35 is rotated alternately in the forward and reverse directions in the wash and rinse steps with the water being reserved in the rotatable tub 8. In a dehydration step, the rotatable tub 8 is rotated at high speeds so that the resultant centrifugal force causes the water to rise up along the circumferential wall of the tub 8. Consequently, the water is discharged through the dehydrating holes 9. Since the generally cylindrical inner basket 21 is disposed in close vicinity to the inner circumferential surface of the rotatable tub 8, the space 25 or a water flow path along which the water flowing out of the water-passing holes 24 rises up is ensured between the inner basket 21 and the inner circumferential wall of the rotatable tub 8. Accordingly, the water can smoothly be discharged through the dehydrating holes 24 without obstruction by the clothes even when the centrifugal force presses the clothes against the inner circumferential wall of the inner basket 21 in the dehydrating step. Consequently, the dehydrating efficiency can be improved.

Since the inner basket 21 formed from a metal is superior in the mechanical strength, the inner basket 21 can sufficiently receive the centrifugal force produced in the dehydration step, so that the rotatable tub 8 can

sufficiently withstand the high-speed rotation even when it is formed from a plastic material. Consequently, the rotational speed of the rotatable tub 8 can be increased to a sufficiently high level in the dehydration step and accordingly, a high level of dehydrating performance can be achieved. In the embodiment, particularly, the upper and lower ends of the inner basket 21 are fixed to the rotatable tub 8. This construction can further increase the mechanical strength of the inner basket 21 against the high-speed rotation, resulting in further increase in the rotational speed in the dehydration step.

The rotatable tub 8 to which the inner basket 21 is fixed is secured to the tub-mounting disc 7. Thus, since the inner basket 21 is connected to the disc 7, the mechanical strength of the inner basket 21 against the high-speed rotation can further be increased. Consequently, sufficient dehydrating performance can be obtained. Furthermore, the upper end of the inner basket 21 is secured to the rotatable tub 8 together with the balancing ring 26. Accordingly, the mechanical strength of the upper portion of the inner basket 21 against the high-speed rotation can be increased and the screws 27 used for securement of the balancing ring 26 can also be used for securing the inner basket 21 to the rotatable tub 8. Consequently, the number of parts can be reduced. Furthermore, since the bottom cover 31 is disposed between the inner basket 21 and the drain hole 10 of the rotatable tub 8 so that the space 25 between the inner basket 21 and the rotatable tub 8

communicates with the drain hole 10. The drain paths can be provided outside the inner basket 21 and below the bottom cover 31. Consequently, since the drainage can smoothly be performed without obstruction by the clothes, the draining efficiency can be improved.

The bottom cover 31 is also disposed so that the space 25 between the inner basket 21 and the rotatable tub 8 communicates with the backside water absorbing area 38 from which the agitator 35 feeds the water into the lint capturing water-flow path 40 vertically extending along the inner circumferential surfaces of the inner basket 21 and the rotatable tub 8. Accordingly, the recirculating water-flow path for capture of lint can be provided outside the inner basket 21 and below the bottom cover 31. Consequently, since the water can smoothly be recirculated without obstruction by the clothes, which improves the lint capturing efficiency. Since the bottom cover 31 is discrete from the inner basket 21, the latter can be formed by rounding a metal plate and connecting both ends of the plate. Consequently, the manufacturing efficiency can be improved. Furthermore, the number of the water-passing holes 24 formed in the inner basket 21 is larger in the lower circumferential wall thereof than in the upper circumferential wall thereof. An amount of wash liquid reaching the dehydrating holes 9 of the rotatable tub 8 from the interior of the inner basket 21 can be reduced in the wash step. Consequently, the damage to the clothes can be reduced. Furthermore, the water-passing holes 24 are formed

by squeezing the circumferential wall of the inner basket 21 outwardly from the inner surface thereof. Since the clothes can be prevented from being caught by the edges of the water-passing holes 24 in this construction, they can further be prevented from being damaged.

The inner basket 21 has a number of expanding portions 22 and 23 expanding outwardly of the circumferential wall thereof so that the space 25 is defined between the expanding portions 22 and 23 and the inner circumferential wall of the rotatable tub 8. Consequently, the paths along which the water rises up in the dehydration step can be ensured more reliably. Consequently, the dehydrating efficiency can reliably be improved. In this regard, the expanding portions of the inner basket may include vertically shorter and longer ones 22 and 23 alternately arranged circumferentially of the inner basket, so that the water flow and the movement of the clothes can be rendered complicate in the wash step. Additionally, the diameter of the inner basket 21 may be substantially the same from the lower end to the upper end thereof or the diameter of the inner basket is smaller at the upper end side than at the lower end side. In this construction, the clothes can effectively be prevented from rising up along the inner circumferential wall of the inner basket 21 in the dehydration step. Consequently, the rotation of the rotatable tub 8 in the unbalanced state and resultant abnormal vibration thereof can be prevented.

The upper and lower ends of the inner basket 21 are

directly secured to the rotatable tub 8 in the foregoing embodiment. Alternatively, these ends may be secured to the balancing ring 26 and the tub-mounting disc 7 respectively so as to be indirectly fixed to the rotatable tub 8. In this regard, when the tub-mounting disc 7 is mounted to be located in the rotatable tub 8, the lower end of the inner basket 21 may directly be secured to the tub-mounting disc 7. Furthermore, the bottom cover 31 may be formed integrally with the inner basket 21 if the manufacturing efficiency of the inner basket 21 does not have priority.

Although the rotatable tub 8 is formed from the plastic material in the foregoing embodiment, it may be formed from a metal such as a stainless steel. The mechanical strength of the rotatable tub 8 can considerably be increased when both of the rotatable tub 8 and the inner basket 21 are formed from the metal. Furthermore, the inner basket 21 may be formed from a plastic material. The mechanical strength of the rotatable tub 8 is more or less reduced when both of the rotatable tub 8 and the inner basket 21 are formed from the plastic material such as polypropylene. However, since these members are connected together, a sufficient strength can still be obtained. Furthermore, the bottom cover 31 may be formed from a metal such as a stainless steel for further improvement of the strength of the rotatable tub 8.

The inner basket 21 may further be formed from a porous material. Since the porous material has a number of pores, provision of the water-passing holes 24 is not necessary. It is preferable that a porous coating should be applied to

the inner circumferential surface of the inner basket 21 for the enhancement in the slipping of cloth. The porous material is preferably formed by sintering a powered plastic material such as polypropylene. Alternatively, the porous material may be formed by sintering a powered ceramic or metal. Furthermore, an antibacterial substance such as the one commercially sold under the registered trademark of "AMORDEN" owned by Yamato Chemical Industry Co., Ltd. in Japan is preferably coated on the inner circumferential surface of the rotatable tub 8 and the outer circumferential surface of the inner basket 21.

FIGS. 5 to 7 illustrate a second embodiment of the present invention. The difference between the first and second embodiments will be described. Identical parts are labeled by the same reference numerals as in the first embodiment. Referring to FIGS. 5 and 6, a folded portion of the lower end of the inner basket 21 is fitted in a groove 42 formed in the lower end of the rotatable tub 8 to be thereby fixed in position. The upper end of the inner basket 21 is held between the upper end of the rotatable tub 8 and the balancing ring 26. The lower and upper ends of the inner basket 21 also have folded portions 43 and 44 respectively.

The rotatable tub 8 has a plurality of water-passing concavities 45 formed in the lower portion thereof so as to be contiguous with the groove 42 and positioned outside the lower end of the inner basket 21 and so as to be spaced from one another circumferentially along the groove 42, as best

shown in FIG. 6. The space 25 between the rotatable tub 8 and the inner basket 21 communicates with the lower space in the rotatable tub 8 via each concavity 45. A number of through holes 46 are formed in the lower end of the inner basket 21 so as to be circumferentially aligned. The space 25 and the water-passing concavities 45 communicate with the interior of the inner basket 21 via the holes 46. The inner basket 21 further has a stepped portion 47 formed in the lower circumferential wall thereof so as to project inwardly. The upper edge of a bottom cover 48 is closely abutted against the stepped portion 47. In mounting of the bottom cover 48 to the rotatable tub 8, a plurality of claws 50 formed on the outer circumferential wall of the bottom cover 48 are engaged with engagement holes 49 formed in the lower portion of the rotatable tub 8 respectively, as shown in FIGS. 5 and 6. Additionally, a plurality of screws 52 are screwed into mounting holes 51 formed in the lower portion of the rotatable tub 8, respectively, so that the bottom cover 48 is mounted on the rotatable tub 8. The bottom cover 48 serves in the same manner as the bottom cover 31 in the foregoing embodiment. The other construction is the same as that in the first embodiment.

The same effect can be achieved in the second embodiment as in the first embodiment. In particular, the lower end of the inner basket 21 is fitted into the groove 42 of the rotatable tub 8 so that the inner basket 21 is fixed. Consequently, since the inner basket 21 need not be provided with a screwing flange or the like, the

configuration of the inner basket 21 can be simplified and the manufacturing efficiency thereof can be improved as compared with the construction of the first embodiment in which the inner basket 21 is fixed to rotatable tub 8 by the screws 30. Furthermore, the bottom cover need not be formed into such a shape that abutment thereof against the bosses 29 can be avoided. Accordingly, since the bottom cover 48 can be mounted so as to be in close vicinity to the inner circumferential surface of the rotatable tub 8, a larger volume of the rotatable tub 8 contributive to the washing operation can be ensured. Furthermore, since the lower end of the inner basket 21 is only fitted into the groove 42 of the rotatable tub 8, the screwing work performed deep in the bottom of the rotatable tub 8 is not required. Consequently, the assembly efficiency can be improved. Additionally, since the lower end of the inner basket 21 is fitted in the groove 42 of the rotatable tub 8 so as not to be exposed, the lint can be prevented from sticking to the lower end of the inner basket 21.

The lower end of the inner basket 21 has the folded portion 43 which is fitted into the groove 42 so that the inner basket 21 is fixed. Accordingly, since the lower end of the inner basket 21 has no edge that tends to be caught by some other parts in the assembly step, the efficiency in fitting the lower end of the inner basket 21 into the groove 42 can be improved. Furthermore, since the provision of the folded portion 42 can increase the strength of the lower end of the inner basket 21, this contributes to the increase in

the rotational speed of the rotatable tub 8 in the dehydration step. Additionally, deformation of the inner basket 21 during the fitting work can be prevented and accordingly, the assembling efficiency can further be improved.

The water-passing concavities 45 are formed in the lower portion of the rotatable tub 8 so as to be contiguous with the groove 42 and positioned outside the lower end of the inner basket 21. The space 25 between the rotatable tub 8 and the inner basket 21 communicates with the lower space in the rotatable tub 8 via each concavity 45. The water-passing concavities 45 prevent the space 25 from being closed. More specifically, a drainage path extending from the space 25 between the rotatable tub 8 and the inner basket 21 can reliably be ensured by the provision of the water-passing concavities 45. Consequently, since the water can smoothly be discharged at the time of drainage without obstruction by the clothes, the draining efficiency can be improved. Furthermore, the through holes 46 are formed in the lower end of the inner basket 21 so as to be circumferentially aligned. The space 25 and the water-passing concavities 45 communicate with the interior of the inner basket 21 via the holes 46. Thus, the draining water-flow path extending from the space 25 can reliably ensured by the concavities 45 and the holes 46. Consequently, the draining efficiency can further be improved and the draining water-flow path can further be prevented from being clogged by the lint. Furthermore, the stepped portion 47 is formed

in the lower portion of the inner basket 21 so as to project inwardly. The stepped portion 47 abuts against the upper edge of the bottom cover 48. The stepped portion 47 prevents the clothes from being caught by the interface between the inner basket 21 and the bottom cover 48. Consequently, the damage to the clothes can be reduced.

FIGS. 8 to 15 illustrate a third embodiment of the present invention. The difference between the third embodiment and the first and second embodiments will be described. Identical parts are labeled by the same reference numerals as in the first and second embodiments. The basic construction of the washing machine of the third embodiment is the same as that of the second embodiment. The major difference consists in the construction of a bottom cover 61. The bottom of the rotatable tub 8 will first be described with reference to FIG. 12. The water-passing concavities 45 are spaced from one another and contiguous with the circumferential groove 42. The circular drain hole 10 is formed in the central bottom of the rotatable tub 8. The tub-mounting disc 7 on which the rotatable tub 8 is mounted has a plurality of elongate water-passing holes 11 formed so as to correspond to the drain hole 10. In this construction, generally linear paths extending from the respective concavities 45 to the side of the drain hole 10 or the holes 11 are main drain paths as shown by arrows 62 in FIG. 12.

Now describing the bottom cover 61, it comprises an annular member having approximately the same curved

circumference as the bottom of the rotatable tub 8 as shown in FIG. 12. The bottom cover 61 has a plurality of tabs 63 spaced from one another along the inner circumference thereof. Each tab 63 has a screw hole. The bottom cover 61 further has a plurality of pairs of ribs 64 extending from the respective tabs 63 toward the outer circumference thereof on its underside. The space between the paired ribs 64 is set to be larger than the width of the tab 63. The rotatable tub 8 has a plurality of tapped holes 51 formed in the bottom thereof. Each hole 51 is located in the portion of the bottom other than the main drain paths or more specifically, each hole 51 is located midway between the main drain paths. Accordingly, no main drain path overlaps the tapped holes 51. Screws 52 are inserted through the respective screw holes of the tabs 63 and then screwed into the respective tapped holes 51 so that the bottom cover 61 is fixed to the rotatable tub 8. Each tab 63 and each tapped hole 51 constitute a fixing portion 65. The fixing portion 65 is provided in the portion of the bottom of the tub 8 other than the main drain paths.

The tub-mounting disc 7 and the seal metal 13 are sealed by a packing 66 serving as an annular sealing member as shown in FIGS. 14 and 15. The seal metal 13 has a stepped circumferential edge and a stepped portion 13a has four engagement holes 13b, for example. The packing 66 has four engagement projections 66a projecting downwardly as viewed in FIG. 14. The engagement projections 66a are fitted into the engagement holes 13b of the seal metal 13 so

that the packing 66 is attached to the seal metal 13. Then, the seal metal 13 with the packing 66 is mounted to the tub-mounting disc 7. Since the packing 66 is precisely attached to the seal metal 13 as the result of fitting engagement of the projections 66a with the respective holes 13b, the sealability thereof can be improved.

The same effect can be achieved in the third embodiment as in the second embodiment. In the third embodiment, particularly, each fixing portion 65 for fixing the bottom cover 61 to the tub 8 is formed in the portion of the tub bottom other than the main drain paths. When the drainage is performed prior to the dehydration step, the water in the inner basket 21 and the water in the space between the inner basket 21 and the tub 8 flow into the drain hole 10 mainly through the water-passing concavities 45, the space between the bottom cover 61 and the tub 8 and the main drain paths. In this case, the water scarcely passes through the fixing portions 65. Thus, the lint can be prevented from being caught by the fixing portions 65 and accordingly, a mass of lint can be prevented from being formed at the fixing portions 65. Consequently, the draining efficiency can be prevented from being lowered.

Each pair of ribs 64 formed on the underside of the bottom cover 61 are opposite to each other with a space therebetween larger than the width of each tab 63 of the fixing portion 65 and extend to the rear of the fixing portion 65, thereby isolating the rear space from the water-passing concavities 45. Consequently, the water from the

water-passing concavities 45 can further be prevented from passing through the rear of each fixing portion 65 and accordingly, the forming of the mass of lint can further be prevented. Although the ribs 64 are formed on the underside of the bottom cover 61, they may be formed on the bottom of the rotatable tub 8 so as to be opposite to the underside of the bottom cover 61, instead.

FIGS. 16 and 17 illustrate a fourth embodiment of the present invention. The difference between the third and fourth embodiments will be described. The bottom of the rotatable tub 8 has a plurality of convexities 67 opposite to the underside of the bottom cover 61. Each convexity 67 is fitted into the space between each paired ribs 64. In this construction, the water can be further prevented from passing through the rear of the fixing portions 65 and accordingly, the forming of a mass of lint can be prevented further effectively. Furthermore, the bottom cover 61 can readily be positioned in the assembly of the washing machine. Alternatively, the ribs 64 may be formed on the bottom of the tub 8 so as to be opposite to the underside of the bottom cover 61 and the convexities 67 may be formed on the bottom cover 61.

FIGS. 18 and 19 illustrate a fifth embodiment of the present invention. The difference between the third and fifth embodiments will be described. The rotatable tub 8 has a plurality of concavities 68 formed in the bottom thereof so as to be opposite to the underside of the bottom cover 61. The paired ribs 64 are fitted into the

concavities 68 respectively. In this construction, too, the water can be further prevented from passing through the rear of the fixing portions 65 and accordingly, the forming of a mass of lint can be prevented further effectively. Furthermore, the bottom cover 61 can readily be positioned in the assembly of the washing machine. Alternatively, the ribs 64 may be formed on the bottom of the tub 8 so as to be opposite to the underside of the bottom cover 61 and the concavities 68 may be formed on the bottom cover 61. Furthermore, although the screws are employed for fixing the bottom cover 61 to the bottom of the tub 8, the bottom cover 61 may be engaged with the bottom of the tub 8 to be thereby fixed thereto, instead.

The foregoing description and drawings are merely illustrative of the principles of the present invention and are not to be construed in a limiting sense. Various changes and modifications will become apparent to those of ordinary skill in the art. All such changes and modifications are seen to fall within the true spirit and scope of the invention as defined by the appended claims.

WE CLAIM:

1. An automatic washing machine comprising:

a) a tub provided for reserving a predetermined amount of water, the tub including a circumferential wall having a number of dehydrating through holes formed in an upper portion of the circumferential wall so as to be arranged circumferentially of the tub, the tub being rotated in a dehydration step so that the water is discharged through the dehydrating holes; and

b) an inner basket formed into a generally cylindrical shape and including a circumferential wall having a number of water-passing holes, the inner basket being disposed in close vicinity to the inner circumferential surface of the tub.

2. An automatic washing machine according to claim 1, wherein each of the tub and the inner basket is formed from a plastic material or a metal.

3. An automatic washing machine according to claim 1, wherein the tub is formed from a plastic material and the inner tub is formed from a metal.

4. An automatic washing machine according to claim 1, wherein the inner basket is formed from a porous material.

5. An automatic washing machine according to any one of

claims 1 to 4, wherein the inner basket has upper and lower ends fixed to the tub.

6. An automatic washing machine according to claim 5, further comprising a tub mounting disc on which the tub is mounted and wherein the inner basket is connected to the tub mounting disc.

7. An automatic washing machine according to claim 5, further comprising a balancing ring mounted on the upper portion of the tub and wherein the upper end of the inner basket is secured to the tub together with the balancing ring.

8. An automatic washing machine according to any one of claims 1 to 4, wherein the tub has a bottom provided with a drain hole and further comprising a bottom cover provided between the inner basket and the drain hole so that a space defined between the tub and the inner basket communicates with the drain hole.

9. An automatic washing machine according to any one of claim 1 to 4, further comprising a water flow path defining cover disposed along the inner circumferential wall of the tub so as to define a water flow path for capturing lint between the same and the inner circumferential wall of the tub, an agitator rotatably mounted on the bottom of the tub, the agitator directing the water from a backside water

absorbing area to the lint capturing water flow path, and a bottom cover provided between the inner basket and the backside water absorbing area so that a space defined between the tub and the inner basket communicates with the backside water absorbing area.

10. An automatic washing machine according to claim 8 or 9, wherein the bottom cover is discrete from the inner basket.

11. An automatic washing machine according to claim 10, wherein the bottom cover is formed from a metal.

12. An automatic washing machine according to any one of claims 1 to 4, wherein the number of the water-passing holes formed in the inner basket is larger in the lower portion of the circumferential wall thereof than in the upper portion of the circumferential wall thereof.

13. An automatic washing machine according to any one of claim 3, wherein the water-passing holes are formed by squeezing the circumferential wall of the inner basket outwardly from the inner surface thereof.

14. An automatic washing machine according to any one of claims 1 to 4, wherein the inner basket has a number of expanding portions expanding outwardly of the circumferential wall thereof so that a space is defined

between the expanding portions and the inner circumferential wall of the tub.

15. An automatic washing machine according to claim 14, wherein the expanding portions of the inner basket include vertically shorter and longer expanding portions alternately arranged circumferentially of the inner basket.

16. An automatic washing machine according to any one of claims 1 to 4, wherein the diameter of the inner basket is substantially the same from the lower end to the upper end thereof or the diameter of the inner basket is smaller at the upper end side than at the lower end side.

17. An automatic washing machine according to any one of claims 1 to 4, wherein the tub has a groove circumferentially formed in the lower portion thereof and the lower end of the inner basket is fitted in the groove of the tub so that the inner basket is fixed in position.

18. An automatic washing machine according to claim 17, wherein the inner basket has a folded portion in the lower end thereof and the folded portion of the inner basket is fitted in the groove of the tub.

19. An automatic washing machine according to claim 17, wherein the tub has a plurality of water-passing concavities formed in the lower portion thereof so as to be contiguous

with the groove and positioned outside the lower end of the inner basket and so as to be spaced from one another circumferentially along the groove, whereby the space defined between the tub and the inner basket communicates with a space located below the lower end of the inner basket.

20. An automatic washing machine according to claim 19, wherein the inner basket has a number of communicating holes formed in the lower portion thereof so that the water-passing concavities of the tub and the space between the tub and the inner basket communicate with a space inside the inner basket via the communicating holes.

21. An automatic washing machine according to claim 8 or 9, wherein the inner basket has a stepped portion formed in the lower portion thereof and inwardly projecting so that the stepped portion abuts against the upper edge of the bottom cover.

22. An automatic washing machine according to any one of claims 1 to 4, wherein the tub has a drain hole formed in the bottom thereof and a plurality of water-passing concavities formed in the lower circumferential wall thereof so that a water flow path is defined between inner basket and the tub and further comprising a bottom cover fixed to the bottom of the tub so that a space is defined between the same and the lower circumferential wall of the tub and

extends from each water-passing concavity to the bottom of the tub, whereby the space between the inner basket and the tub communicates with the drain hole, and wherein the tub has a fixing portion formed in the portion thereof other than the portion defining a main drain path extending substantially linearly from each water-passing concavity to the drain hole side, the bottom cover being fixed to the fixing portion of the tub.

23. An automatic washing machine according to claim 22, wherein either the underside of the bottom cover or a portion of the bottom of the tub opposite to the underside of the bottom cover has a pair of ribs opposite to each other with a space therebetween larger than the width of the fixing portion of the tub and extending to the rear of the fixing portion so that the rear space is isolated from the water-passing concavities.

24. An automatic washing machine according to claim 22, wherein either the underside of the bottom cover or a portion of the bottom of the tub opposite to the underside of the bottom cover has a pair of ribs opposite to each other with a space therebetween larger than the width of the fixing portion of the tub and extending to the rear of the fixing portion so that the rear space is isolated from the water-passing concavities and the other has a convexity fitted in the space between the ribs.

25. An automatic washing machine according to claim 22, wherein either the underside of the bottom cover or a portion of the bottom of the tub opposite to the underside of the bottom cover has a pair of ribs opposite to each other with a space therebetween larger than the width of the fixing portion of the tub and extending to the rear of the fixing portion so that the rear space is isolated from the water-passing concavities and the other has a concavity in which the ribs are fitted.

26. An automatic washing machine comprising:

a) an outer cabinet;

b) an outer tub mounted in the outer cabinet;

c) a tub rotatably mounted in the outer cabinet for reserving a predetermined amount of water, the tub including a circumferential wall having a number of dehydrating through holes formed in an upper portion of the circumferential wall so as to be arranged circumferentially of the tub, the tub being rotated in a dehydration step so that the water is discharged through the dehydrating holes;

d) an inner basket formed into a generally cylindrical shape and including a circumferential wall having a number of water-passing holes, the inner basket being disposed in close vicinity to the inner circumferential surface of the tub;

e) an agitator rotatably mounted on the bottom of the tub; and

f) a drive mechanism driving the agitator in a wash

step and the tub in a dehydration step.

27. A washing machine substantially as herein described with reference to the accompanying drawings.